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Design and Construction of an Oil Separator with a Water Purifier

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Abstract

Various water-based emulsions, such as those used in the sugar factory, food processing, and chemical sectors, are used as productivity-enhancing coolants in metalworking industries. This emulsion is a specialized blend of water and various types of cutting oils. The sugar factory's wastewater has caused contamination. The sugar industry requires enormous quantities of water daily, and the treated water must be discharged into the river. The low pH value of the treated water renders the land unusable for cultivation, which is a hazardous situation. The oil and grease content in water has consequences for both humans and the environment. Due to the presence of chemicals in water, aquatic life is on the verge of extinction. To avoid all of these issues, manufacturers produce oil skimmers with an endless belt. These skimmers use a geared motor that continuously rotates a Belt comprised of a specific substance that permits oil particles to adhere to it. The oil particles are then scraped and collected in a separate oil collection receptacle. The goals are to separate the oil from the water and to purify the water of any impurities. High efficiency and compliance with environmental laws for water reuse Belt-type skimmers employ a stainless steel, elastomer, or poly medium belt that is dropped into the tank or vessel to be skimmed. The belt traverses robust wiper blades that remove oil from both sides of the medium.

Keywords: *Oil Separator, Water Purifier, Elastomer, pH value, Gear box*

INTRODUCTION

The 21st century is knocking on the door of the world. Rapid industrialization has positioned our nation as the tenth most industrialized nation in the world. The INDIA ranks third in the world in terms of technological talent and manpower. Rapid industrialization afforded the nation the chance to strengthen our economy. However, it has also caused a great deal of complications.

The term "pollution problem" is diverse. Pollution has caused numerous issues in the industrial sector. Pollution encompasses sugar factories. These are captured by water, air, and sound, among others. The sugar factory's wastewater has caused contamination. The sugar industry requires enormous quantities of water daily, and the treated water must be discharged into the river.

The low pH value of the treated water renders the land unusable for cultivation, which is a hazardous situation. The oil and grease content in water has consequences for both humans and the environment. Due to the presence of chemicals in water, aquatic life is on the verge of extinction.

The 'Oil Skimmer' is a brand-new piece of mechanical equipment used for oil spill pollution management. Oil skimmers aid in the separation of oily effluent from waste water. By eliminating oil from waste water, oil pollution is eliminated. The oil skimmer is able to remove even a thin oil layer floating on the water. This is primarily attributable to the "Oleophilic substance" utilized in the oil skimmer. These oil skimmers are custom-made for the effluent treatment facility. Where huge above-ground tanks or ponds prevent gravity drainage, the collected oil is pushed away using a pumping system.

Belt-type oil skimmers are recommended for subterranean storage tanks of modest capacity. Oil refineries, sugar mills, petrochemical plants, etc., are the industry’s most susceptible to oil spillage issues. As oil is not biodegradable, oil spills contribute to severe water contamination. The majority of sugar industry leakage originates from the mill portion.

Every sugar factory uses 200 to 300 liters of oil and greases every day to lubricate its hefty gears. When oil spills over water an emulsified layer forms At every sugar factory's effluent treatment plant (E.T.P.), oil recovery poses a significant threat to the quality of treated effluent water. To separate the oil from the water and to

purify the water of any impurities To recycle water, High performance and compliance with environmental requirements. Belt-type skimmers employ a stainless steel, elastomer, or poly medium belt that is dropped into the tank or vessel to be skimmed. The belt traverses robust wiper blades that remove oil from both sides of the medium.

Oil skimmers are machines used to collect oil floating on the surface of a fluid. In general, oil skimmers function because they are constructed from substances to which oil is more likely to adhere than the fluid over which it floats. In addition, the fluid has a low attraction for oil skimmers. Typically, oil skimmers are sufficient to extract oil from a liquid. In certain instances, oil skimmers may be used to pre-treat fluids.

In this instance, the oil skimmers remove as much oil as possible prior to employing more costly and time-consuming procedures. Using oil skimmers to pre-treat the fluid minimizes the total cost of cleaning the fluid.

SELECTION OF COMPONENTS

Motor

AC 230v reversible synchronous motor with a 300 rpm speed and 50 Hz frequency The motor weighs 140 grammas and has a torque of 80g-cm. It must be equipped with a gearbox for speed reduction. Permanent magnet type MTR5 reversing synchromesh motor with two stator windings for single phase AC50/60Hz. By connecting a capacitor in series with one of the stator windings, the phase of the excitation current can be altered.

The rotational perception is determined by the ensuing circular rotating field. A single-pole changeover switch affects the electrical reversal of rotational direction. The 12 pole rotor's shaft is made of steel. The motor may be equipped with a mounting plate or screw clip for attachment.

Gear Box

The motor is attached to a gearbox for speed reduction with a torque of 10kg-cm and a mass of 65g. The entire motor and gearbox system is installed in the moulded box. One end of the gearbox shaft is connected to the motor shaft, while the opposite end is connected to the coupler.

Belt

The belt should be composed of a material that can effortlessly carry oil above the head and dump it over the blade.

The oil is lifted through the belt due to the inherent qualities of its materials:

1. Belt materials are chosen based on their polar and non-polar characteristics. Water is made up of polar molecules such as H+ and OH-, but oil is devoid of polar molecules and hence responds as a non-polar element. Polar and non-polar molecules attract and bond with their corresponding elements. In addition, oil has a lower density than water, thus it constantly floats on top of it. Consequently, water and oil form distinct layers in the reservoir. Belt material has been chosen so that it reacts as a non-polar element and oil is attracted to it and adheres to it, allowing us to easily lift oil via the belt. Here, we are selecting polymer belt materials (non-polar). Comparable to Cotton, Steel, Rubber, Polyurethane, and Oleophilic.

2. The sticky property of oil is stronger than that of water, so we choose a material for the belt that has an adhesive property greater than that of water and is close to oil, so that it can easily absorb oil over the belt, which eventually separates from water. Due to water's low adhesion, it does not adhere to the belt and remains in the reservoir.

Common types of belts include the following:

a) Corrosion Resistant Steel: One of our most widely used belt materials. Effective in the majority of industrial applications where rust inhibitors are absent from the wash water..
Used On: All skimmers with the exception of Petro Extractor.

b) **Elastomer:** Able to withstand rough and harsh conditions. Used in situations where rust inhibitors are present in the wash water.
Used On: All skimmers

c) **Standard Polymer:** Reinforced to prevent elongation, able to handle moderately high temperatures (up to 170°F), and textured to hold a little amount of oil, hence attracting additional oil with subsequent passes. When rust inhibitors and temperature are present in the wash water or UV sensitivity is a concern.
Used On: All skimmers

d) HT (High Temp) Polymer: Similar to Standard Polymer, but suitable for use at temperatures up to 180°F

(continuous). When a smoother surface is necessary, it is also employed.

Used On: All skimmers

e) **Nylon Polymer:** The unending belt is the most essential component of our method. We are essentially going to move this belt on the surface (a mixture of oil and water) since the belt is composed of a combination of "nylon and polymer" with oil-adherent properties. This belt is attached to two pulleys, one of which is fastened to the motor and the other to the upper portion of the hopper/container. It is constructed from polymer material. It is an unending type with a 50 mm width. The material is chosen so that oil will adhere to the belt. Attached to the aluminum pulley. The length of the belt is 1500 millimeters. It is submerged in liquid to a depth of 150 mm.

Hopper (container)

Therefore, the hopper is the location where we will store the waste oil and water mixture. The square or spherical shape of the hopper (container) does not play a significant role in our production. We simply need to meet one criterion, which is the liter capacity. The fabrication process will involve sheet rolling. We will mostly utilize the MS plate because it is inexpensive and readily available.

Oil Scrapper

The oil scraper is the equipment that will be used to store the separated oil. The belt has been attached to this scraper. There will be one little rectangular MS sheet attached to the scrapper. That will come into touch with the belt and separate the oil.

Aluminum pulley

Two pulleys will be used to support the belt and provide an infinite belt drive. This procedure is a crucial component of the system. The adoption of aluminum pulleys is due to their resistance to corrosion. That means they will not corrode if they come into contact with the oil.

M. S. roller

It is constructed from mild steel. It is suspended from a belt in the liquid. Due to its weight, it helps to maintain the belt's straight position.

Molded box

It is made up of asbestos, which is made up of plastic granules that are molded together. It's where the motor, gearbox, and other electrical components are

mounted. It's also utilized for security reasons

Water filter

A water filter filters contaminants from water using a fine physical barrier, a chemical process, or a biological process. Filters clean water to various degrees for agricultural irrigation, drinking water accessibility, public and private aquaria, and the safe usage of ponds and swimming pools.

Water filters that are commonly used include:

1. **Activated Carbon Filters:** These are also known as carbon filters or pre-filters, and they are in charge of eliminating bigger particles from your water such as sediment and silt. They function by attracting and absorbing these particles, removing them from the liquid that flows through your faucet. An activated carbon filter will help ensure that the final product has less odour and tastes better. This is because they lower the amount of chlorine and other impurities in your water, which can make it smell bad or taste bad.

2. **Reverse Osmosis:-** This filter is quite popular since it can eliminate a wide range of contaminants that could be damaging to your health while also ensuring that the final product is clear and odor-free. If you want to learn more about reverse osmosis water filtration, go to my reverse osmosis water filtration site.

3. **Alkaline/Water Ionizers:-** These filters use a process known as electrolysis. What this means is the water is passed over plates which are electrically charged, and it’s separated into two streams. One is alkaline and the other is acidic. Not only do you get softer water as a result, water that’s low in acidity is much better for your skin as well.

4. **UV Filters:** These filters are possibly one of the most recent technologies available. When ultraviolet radiation is used to disinfect water, it can kill a variety of microorganisms that are harmful to your health. This filter may be the answer if you want a more environmentally responsible approach to purify your water because it works without the need of chemicals or additional heat.

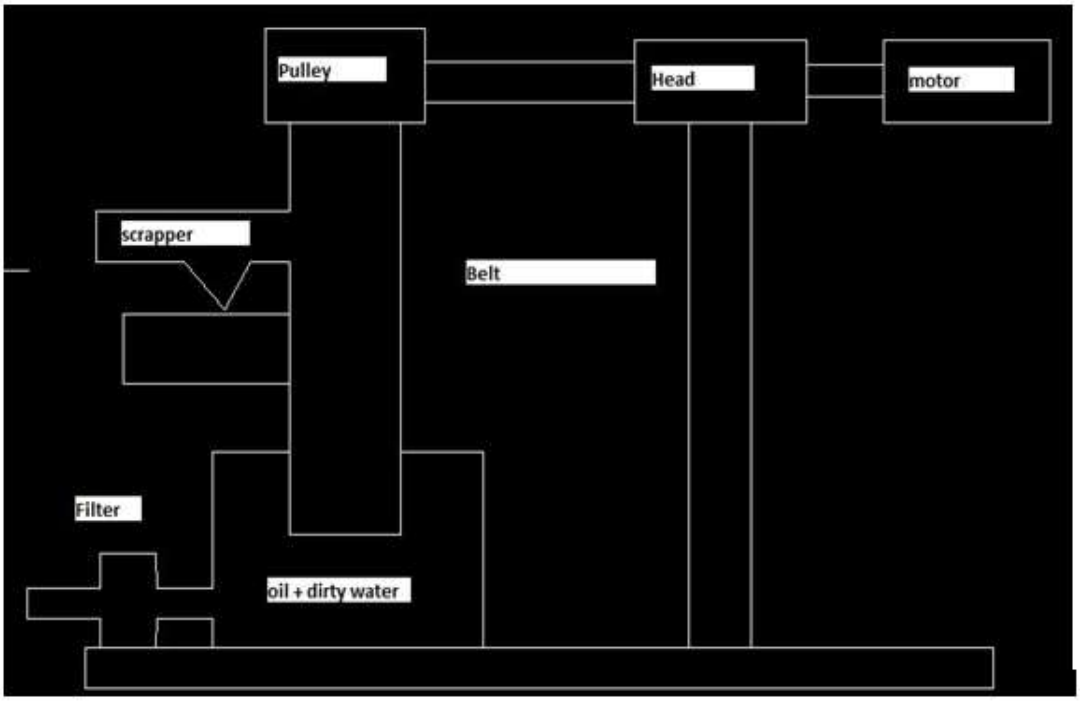
5. **Infrared Filters:** This technology, like alkaline filters, is used to soften water,

so if you reside in a hard water location, infrared technology can help. Infrared filters, like alkaline filters, use heat and light to negatively charge the water and soften it.

A manual water purifier is used to remove pollutants and dirt particles from the water. Cotton, coal, sand, stone particles, and other materials are used to make this.

Working

First, the motor was started by turning on the power supply. The motor's speed is lowered as it is attached to the gearbox. As soon as the aluminium pulley is attached on the motor's shaft, it begins to rotate. The aluminium pulley is attached to the shaft using a grub screw to prevent the pulley from slipping during operation. The belt is attached to the pulley so that it rotates at the same speed as the pulley. The roller is rotated by the belt. The oil in the liquid sticks to the belt as the roller is immersed in the liquid with the help of the belt. With the use of a scrapper, this oil is separated. The oil is collected in a separate tank, which separates the oil from the liquid. Turn off the power once the operation is finished. Then, through the valve supplied to the filter, only unclean water remains in the hopper. Filtration is carried out in the filter, which filters the water. And this cleansed water is used to a variety of uses.



RESULT

PARAMETERS	VALUES		MPCP STANDARD
	1	2	
pH	7.87	7.38	5.5 – 9.0
Total Suspended Solids	488.0	8.0	<100.0
Total Dissolved Solids	598.0	624.0	<2100.0
Chlorides as CI	78.0	77.0	<600.0
Oil & Grease	37.0	4.0	<10.0

CONCLUSION

Separation procedures are critical components of industry's technological base. Separation technologies are important in industrial processes, but they also give potential for waste reduction and increased efficiency. The removal of undesirable oil from water saves both the environment and money. In comparison, the belt skimmer produces the best results. Given the constraints, the separator is basic in design and quite dependable.

The test results suggest that the design meets its goal. It has proven to be extremely useful for skimming oil for the operator. It is extremely beneficial to operators since it eliminates the arduous task of skimming oil and grease from waste water. It also assists in controlling the water pollution.

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